Energy Efficiency in California Standards and Programs

美国加利福利亚州能效标准和能效项目

International DSM Implementation Forum

Beijing, February 26, 2009

国际电力供求侧管理实施论坛

北京，**2009年2月26日**

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Chair, Energy Efficiency Committee
California Energy Commission

加利福利亚州能源委员会主席

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http://www.energy.ca.gov/commissioners/rosenfeld.html

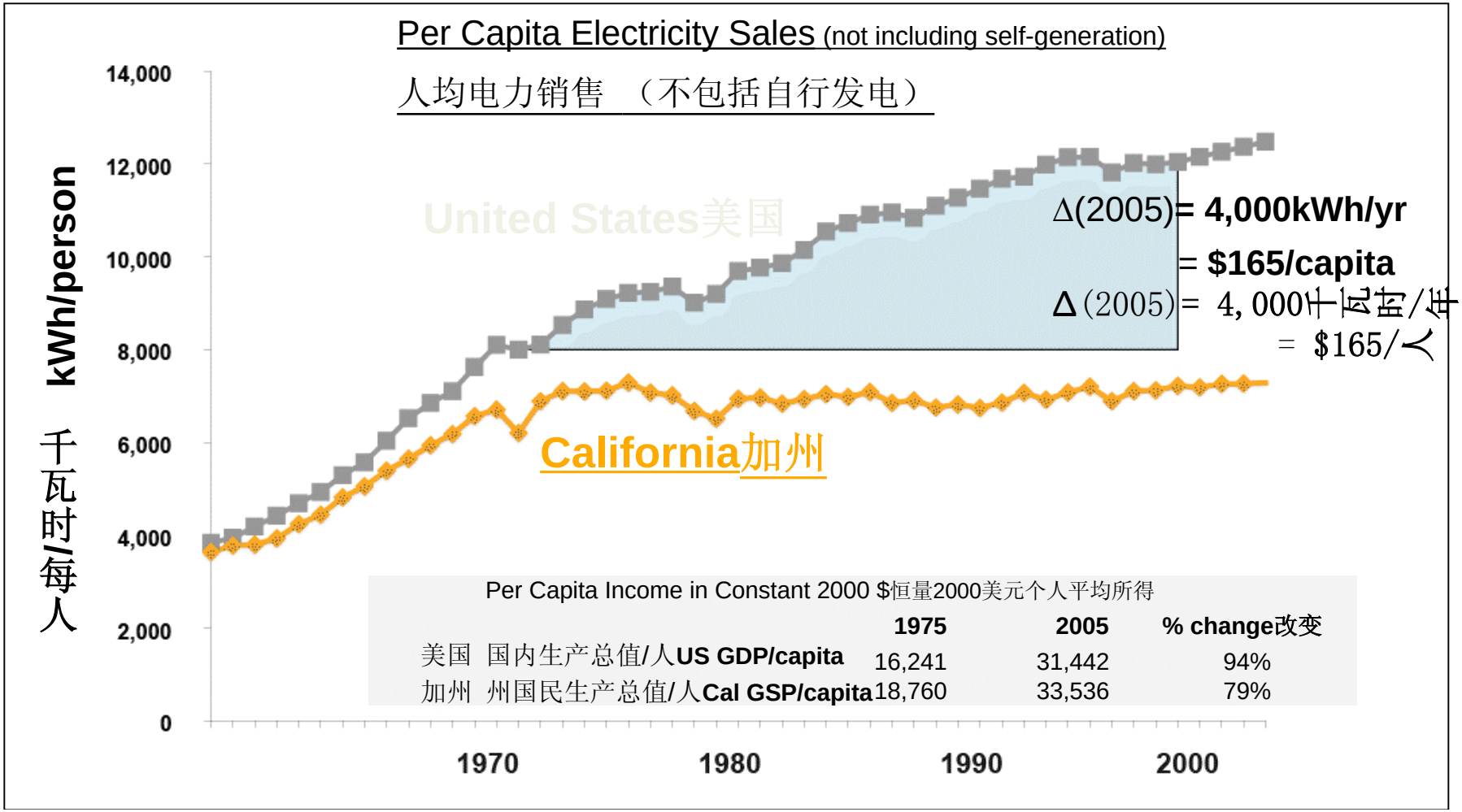
or just Google "Art Rosenfeld"

请访问以上网站，或直接Google "Art Rosenfeld"

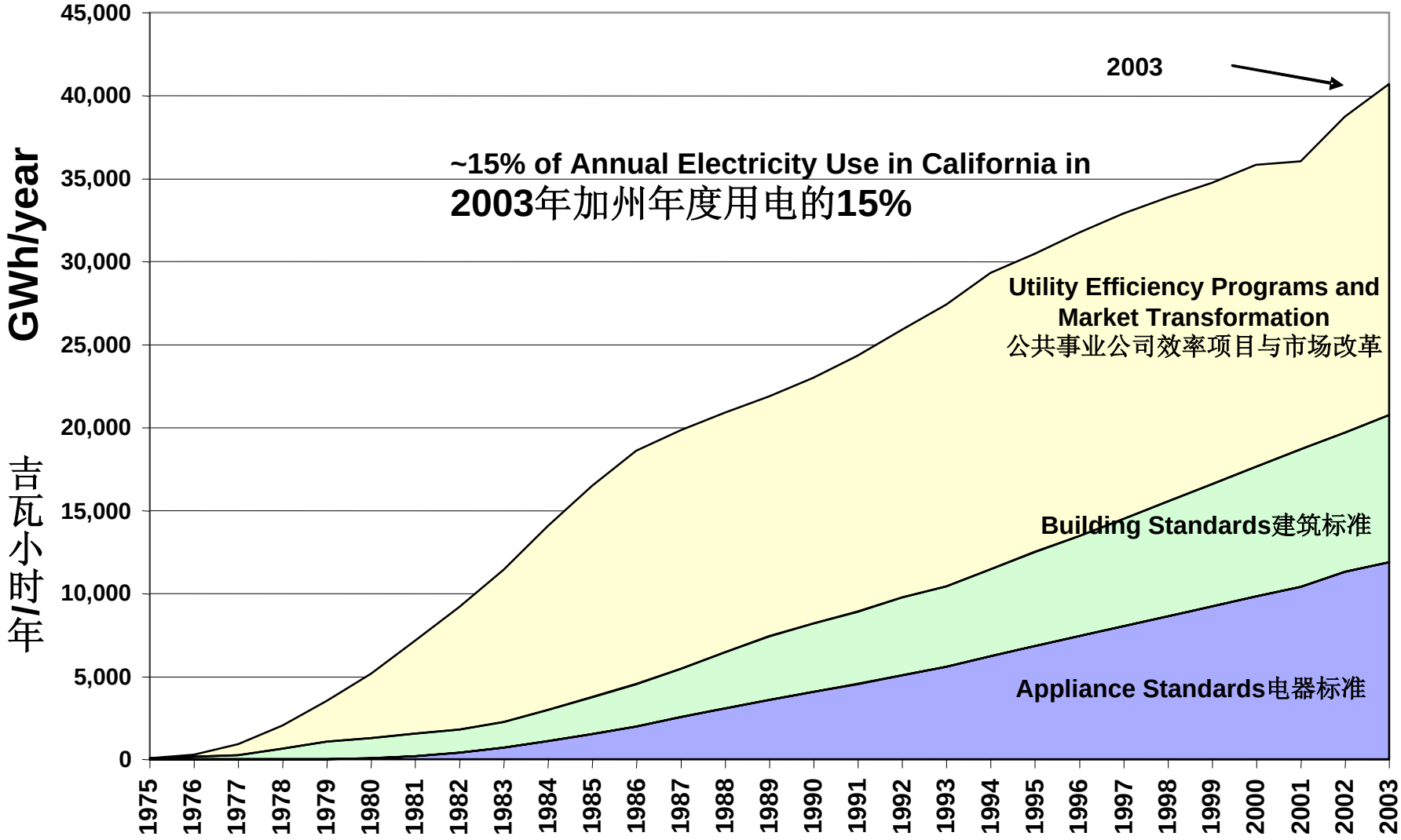
Electricity Use in California
加州电力使用

While US electricity has steadily grown, California has become a model of energy efficiency.

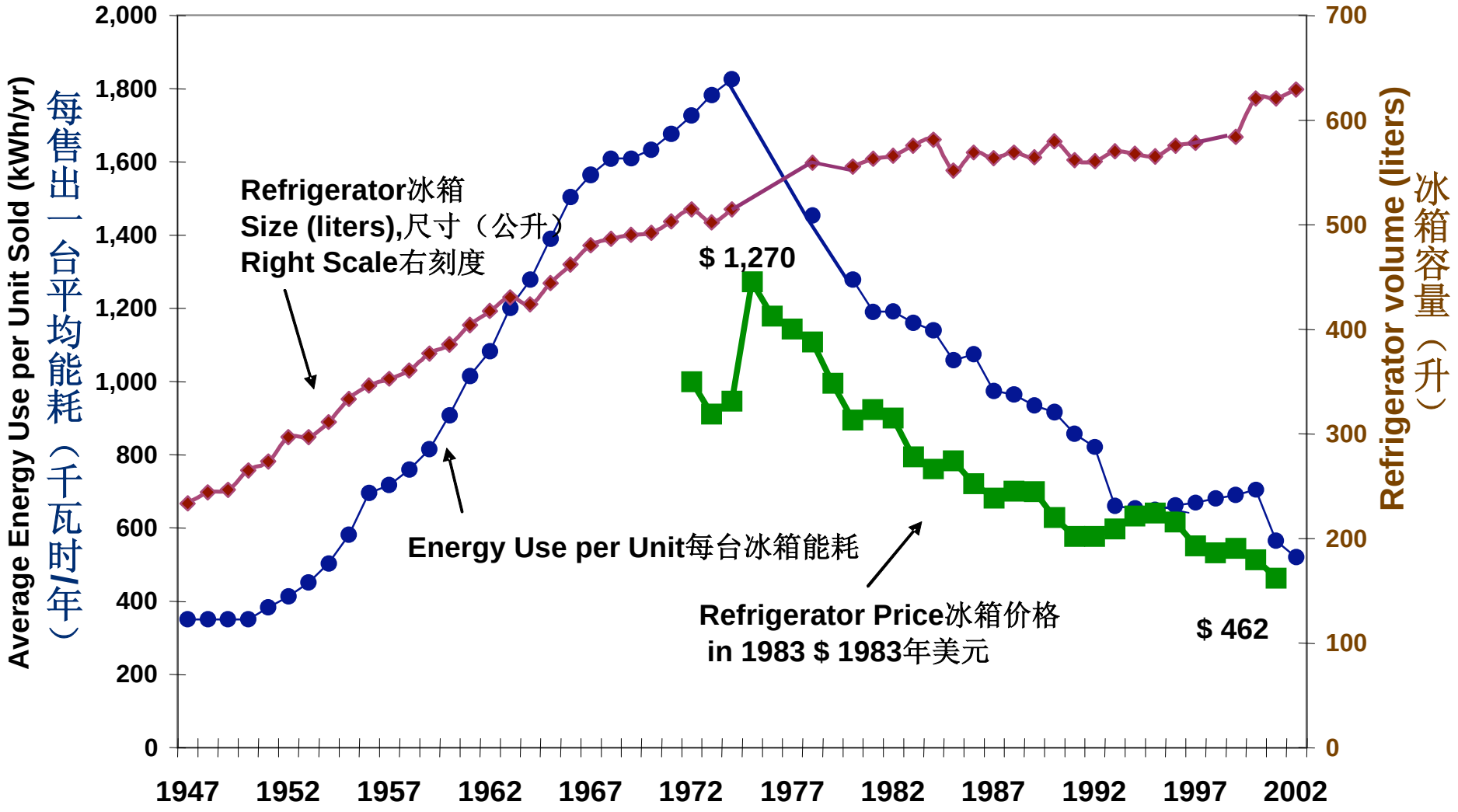
美国用电稳步增加，加州成为能源效率的典范。



Annual Energy Savings from Efficiency Programs and Standards
能效项目和能效标准产生的年能源节省

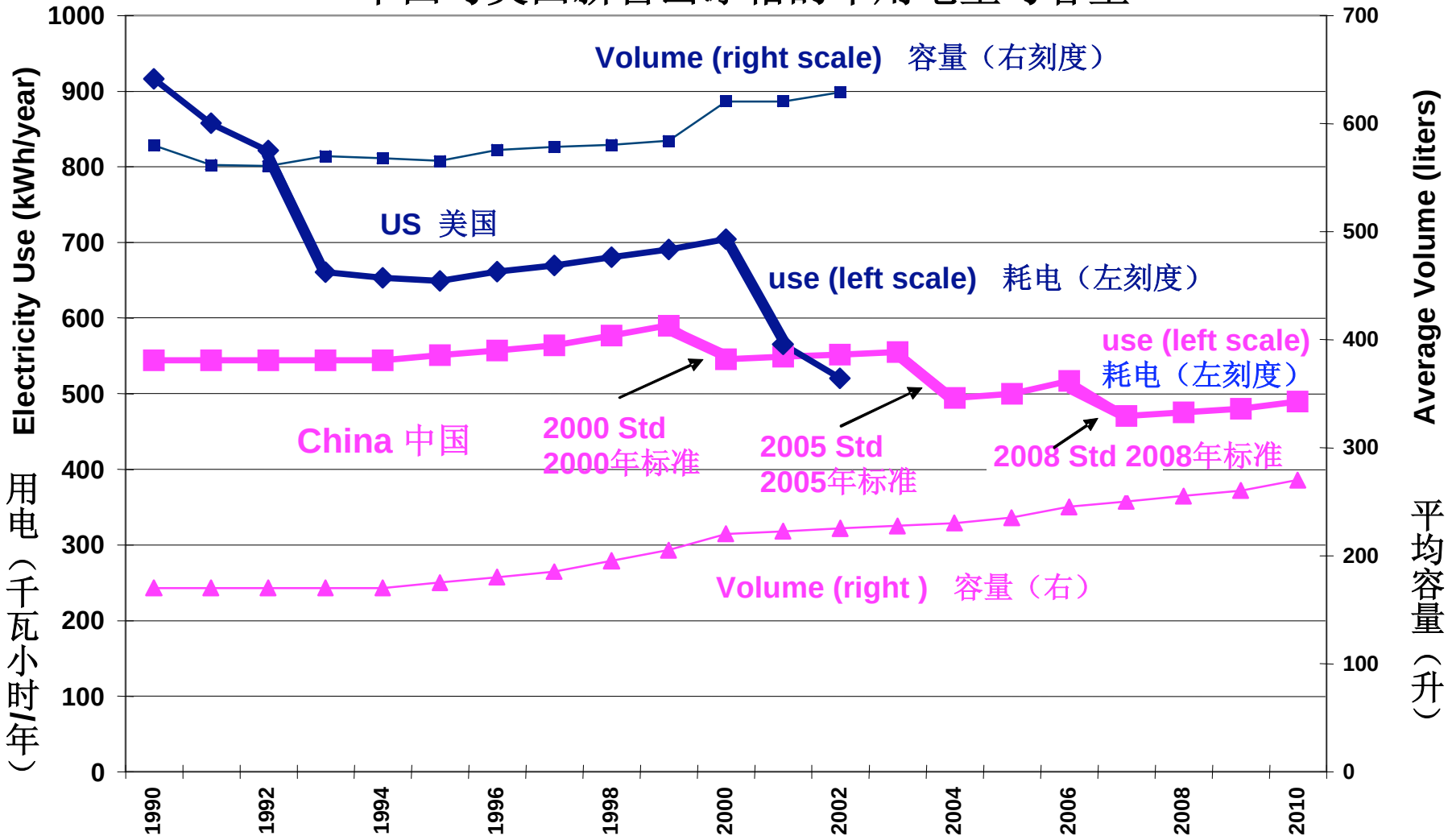


United States Refrigerator Use v. Time
美国冰箱使用与时间



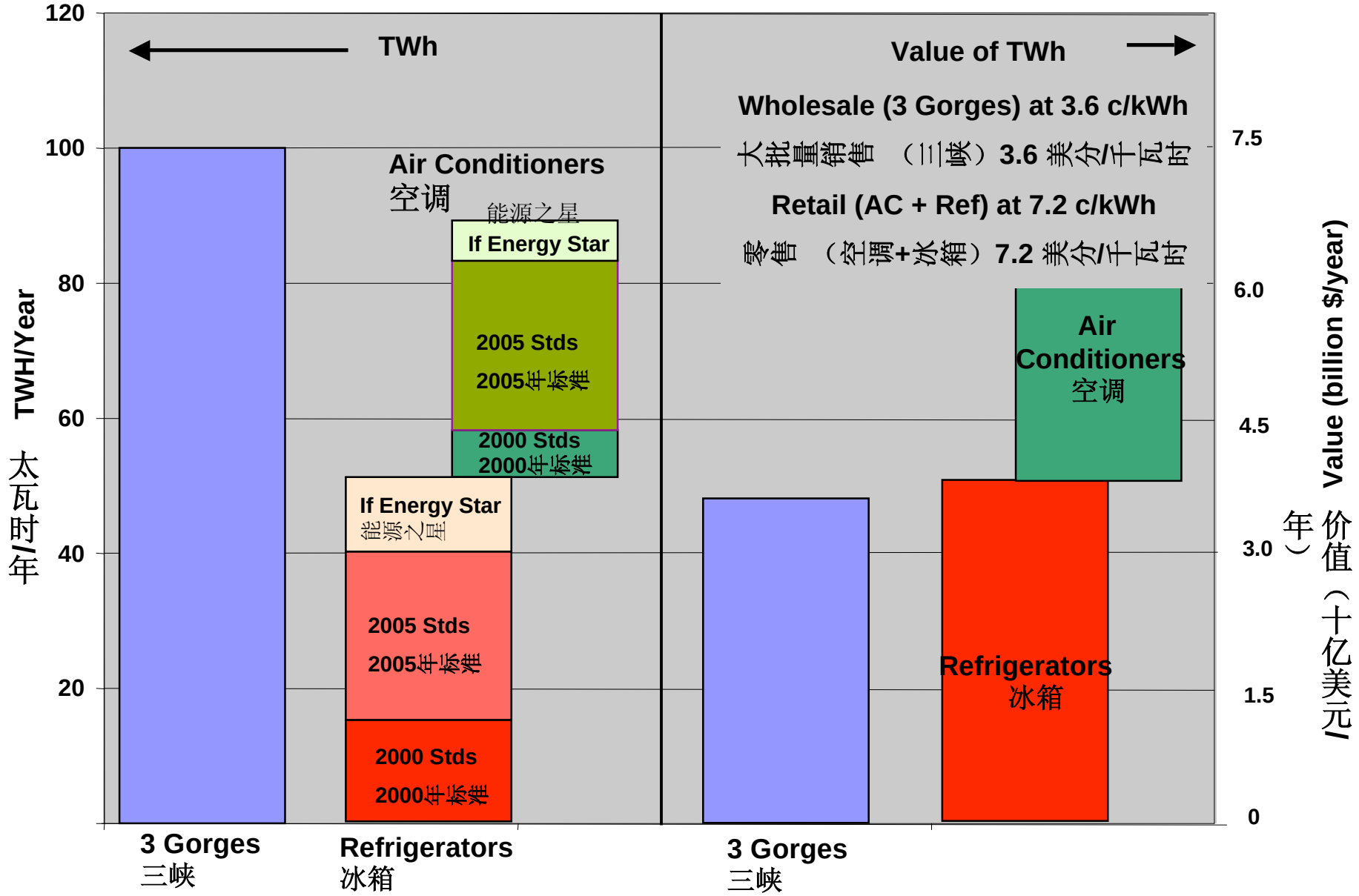
Annual Electricity Use and Volume of a New Refrigerator Sold in China and the US

中国与美国新售出冰箱的年用电量与容量



Sources来源:
DGFridley@LBL.gov and DGoldstein@NRDC.org

Comparison of 3 Gorges to Refrigerator and AC Efficiency Improvements
三峡与电冰箱、空调能效改进对比



Note: Savings calculated 10 years after standard takes effect.
Calculations provided by David Fridley, LBNL

注：标准生效后10年节能量，计算由美国劳伦斯伯克力国家实验室 David Fridley提供

The CEC is now regulating TVs
加州能源委员会
已经开始对电视的能耗进行管理

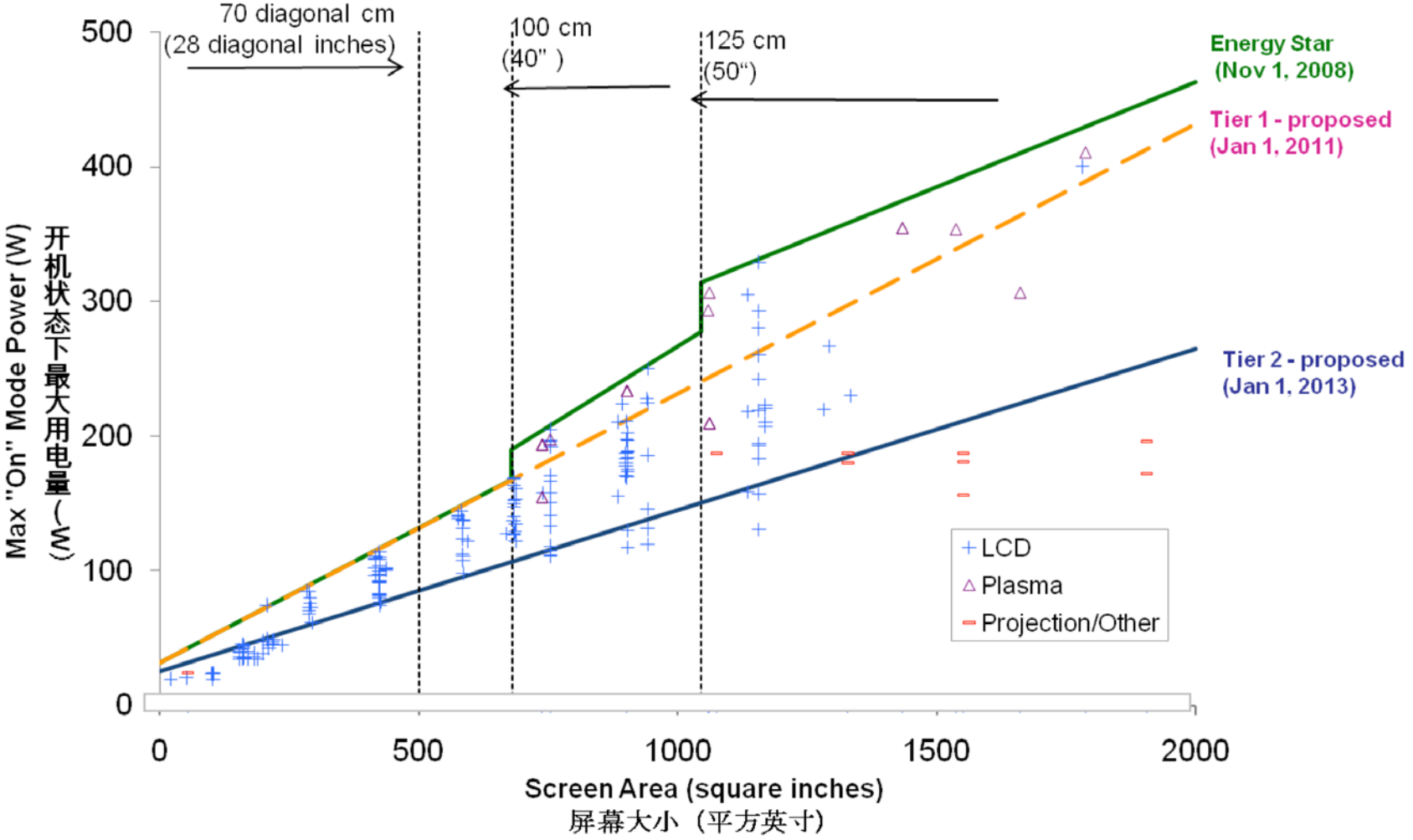
- Sales of conventional (CRT) televisions are rapidly declining in favor of flat screen technology (LCD) .
- 传统显像管电视（CRT）的销售量已经开始快速下滑，而平板电视技术（LCD）更受消费者的青睐。
- TV load is now 10% of total residential electricity load and is growing ~ 3-4% per year.
- 电视用电量目前占住宅用电总量的10%，而且还在以每年3-4%的比例上升。
- Standards will cap or reverse growth!
- 能效标准却可以控制甚至扭转这个上升的趋势！

Power Consumption by TV vs Total Residential in CA, 36 Million people
电视用电量 **vs** 加州住宅用电总量
（加州人口为**3600**万）

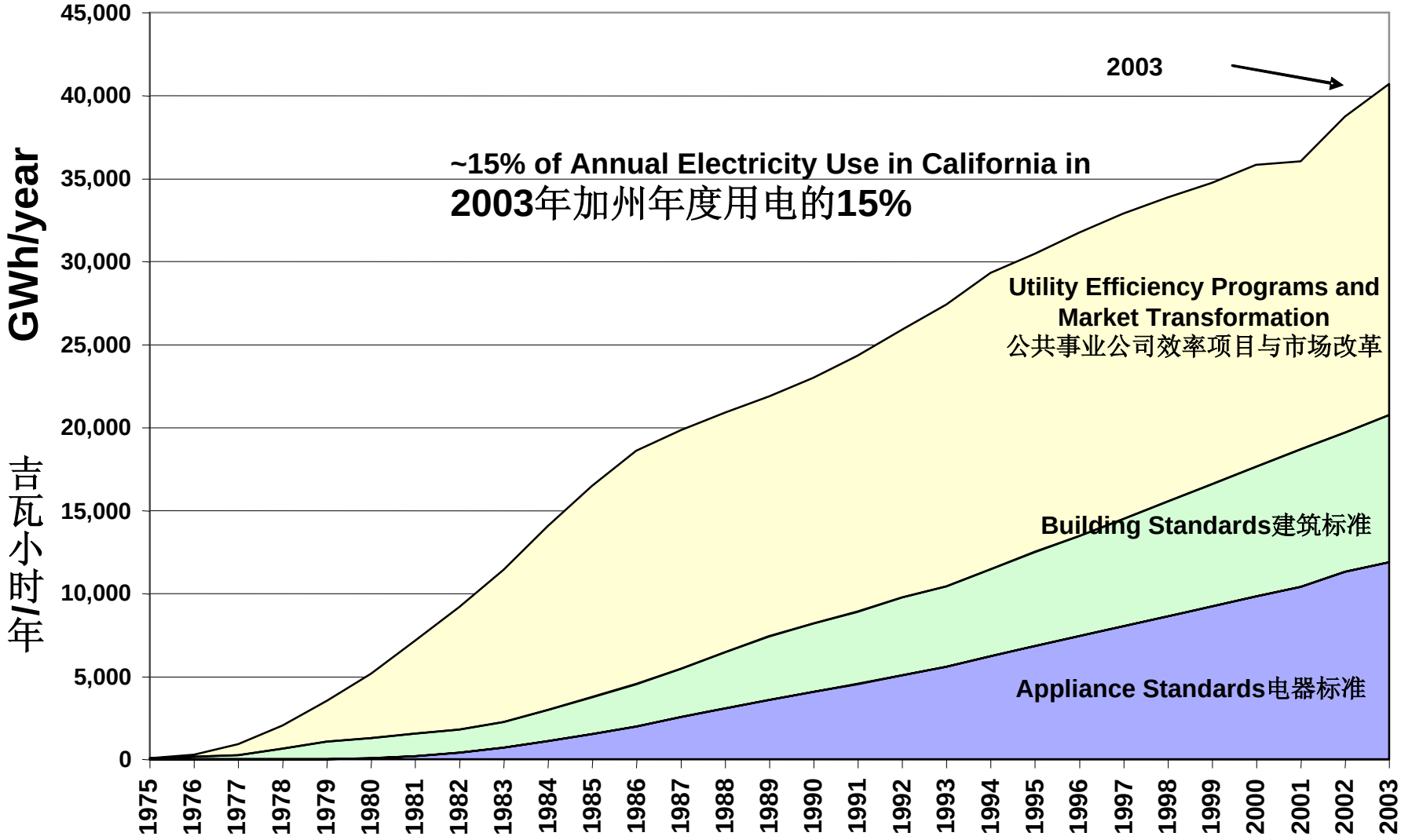
	Power Use (W) by Average Size TV 平均一台电视的耗电量 （W)	**CA Energy Consumption Per Year in Billon kWh/year** 加州每年能耗（十亿千瓦/年）
CRT (Cathode Ray Tube) （显像管电视）	101	4
LCD (Liquid Crystal Display) （液晶电视）	144	3
Other 其他	---	2
Total TV 电视用电总量		9
Compare Total Residential Electric Use 与住宅用电总量相对比		90

Proposed Standards and "Energy Star" Data

提交的能效标准计划和"能源之星"数据



Annual Energy Savings from Efficiency Programs and Standards
能效项目和能效标准产生的年能源节省

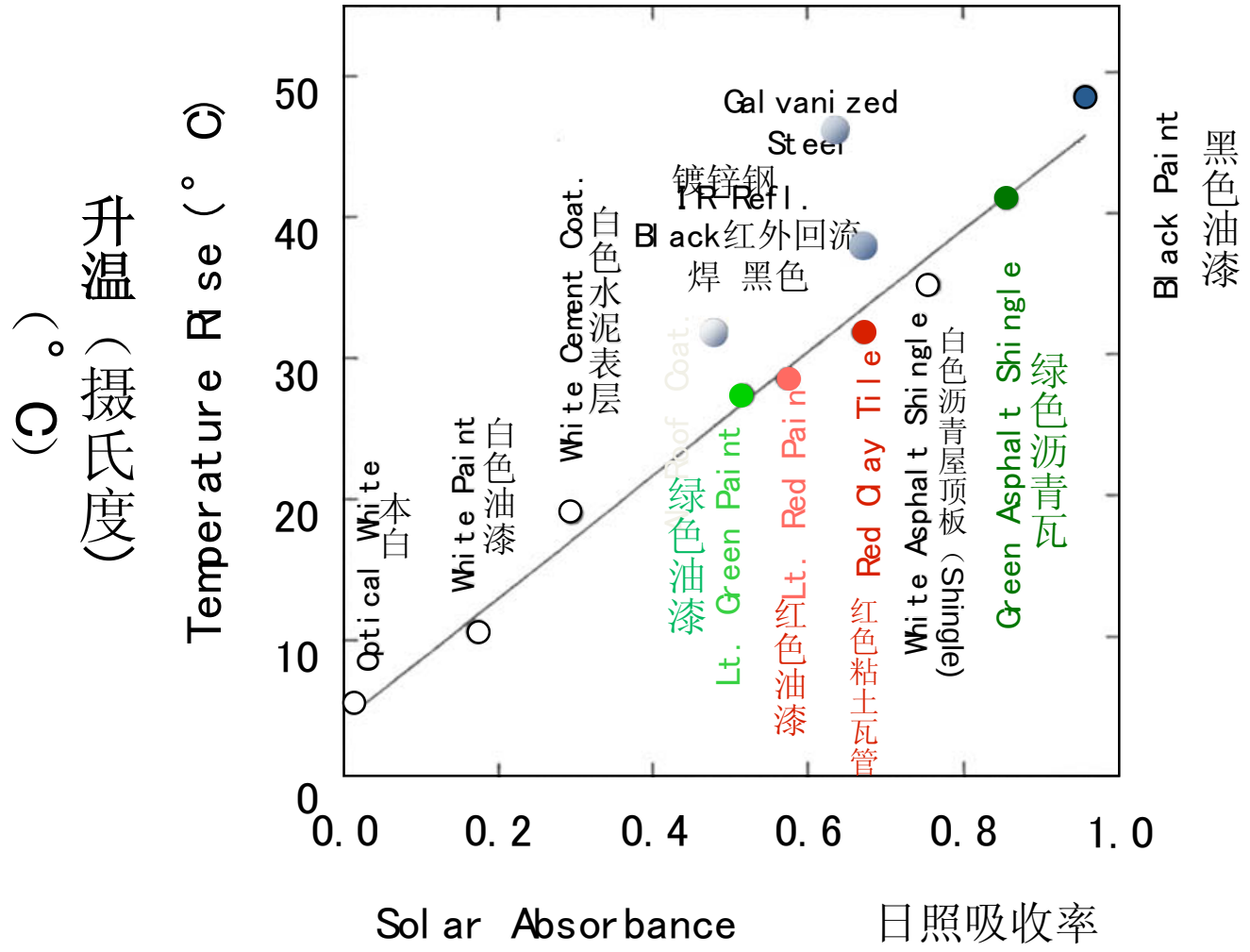


Types of Energy Efficiency Programs
能效项目类型

1. **Rebate** – Upstream (to manufacturers), Midstream, (e.g, to installers of roofs or windows), or Retail
2. **Audit** – Inspection of a home or business to identify energy efficiency opportunities
3. **Direct Install** – Installation of energy efficiency measures at no cost to the customer
4. **Appliance Turn-In** – Takes inefficient appliances out of circulation with free or rebated recycling services
5. **Education** – Training for the general public as well as trade allies such as builders or building operators
6. **Performance Contracting** – Typically nonresidential programs; provides rebate for equipment and building retrofit per unit of energy saved rather than per measure purchased or installed
7. **Energy Management Services** – Typically Nonresidential programs. A combination of audit services, rebates and/or direct install, as well as load management and self-generation

1. **折扣** – 上游 （到制造商）, 中游（如安装屋顶或窗户），或者是零售，即用户
2. **审查** – 检查住宅或公司，确定其能源效率机会
3. **直接安装** – 安装能效措施，不对用户产生任何费用
4. **电器对换** – 提供免费或打折的在循环服务，使低效电器停止流通
5. **教育** – 对普通公众、贸易伙伴如施工人员或建筑管理人员，进行培训
6. **业绩挂钩** – 典型的非住宅项目；根据节约的能源量，而不是购买或安装的措施数量，对设备和建筑物翻新提供折扣
7. **能源管理服务** – 典型的非住宅项目。综合了审查服务、打折和/或直接安装，以及负荷管理和自行发电

Temperature Rise of Various Materials in Sunlight
各种物品在日照下的升温情况



White Roofs
白色屋顶

- In California and a growing number of US states, white roofs are required for new buildings, and re-roofing to reduce air conditioning load and "smog"(O_3).
- 在加州以及越来越多的美国其他州内，白色屋顶是修建新建筑和重新更换屋顶时必须使用的，从而达到降低空调用电量以及"烟尘"(臭氧O_3).的作用
- But a new concept is that white roofs also cool the world directly.
- 同时，一个新发展的理念是：白色屋顶还可以直接降低地球的温度。

Akbari et al. Main Finding 主要发现

100 m^2 of a white roof, replacing a dark roof, offset the emission of 10 tons of CO_2

每用**100**平方米的白色屋顶替代黑色屋顶，就可以抵消**10**吨的**CO_2**

论文来源：

Akbari, H., S. Menon, and A. Rosenfeld. 2008. “Global cooling: increasing solar reflectance of urban areas to offset CO2,” 2008, *Climatic Change*.

http://www.energy.ca.gov/2008publications/CEC-999-2008-020/CEC-999-2008-020.PDF,

or just Google “Akbari, Menon, Rosenfeld”

请查询以上的网页链接，

或者直接Google“Akbari, Menon, Rosenfeld”

Effect of Solar Reflective Roofs and Pavements in Cooling the Globe
太阳能反射屋顶和路面对全球降温的作用

(Source: Akbari, Menon, Rosenfeld. *Climatic Change*, 2008)

（来源： Akbari, Menon, Rosenfeld. *Climatic Change*, 2008）

	Δ Solar Reflectivity Δ太阳能反射率	CO_2 Offset by 100 m^2 每100m^2 抵消的CO_2	CO_2 Offset Globally 全球范围内抵消的CO_2
White Roof 白色屋顶	0.40	10 tons **	
Average Roof * 屋顶平均*	0.25	6.3 tons	24 Gt
Cool Pavement 冷铺路面	0.15	4 tons	20 Gt
Total Potential 总体潜能			44 Gt
Value of 44 Gt CO_2 at \$25/t ~ \$1 Trillion 若按每吨25美元的CO_2计算，44Gt的CO_2, 共可节省约1万亿美元			

*White Roof will be “diluted” by cool colored roofs of lower reflectivity, and roofs that can not be changed, because they are long-lived tile, or perhaps they are already white.
白色屋顶被有更低反射率的冷彩色屋顶“冲淡”了，而且房顶一般不会改变，因为他们是长寿命的瓦片，或者他们已经是白色的了。

**Compare 10 tons with a family car, which emits ~4 tons/year.
可以把这10吨抵消的CO_2，与一辆家庭用车比较。一辆家庭用车每年排放4吨CO_2。

Additional Backup Slides, not for Forum

Advanced Metering Infrastructure (AMI)/Smart Meters
先进的测量设备 (AMI)/智能仪表

- Goal: Install "**smart meters**" and communicating thermostats throughout California

  目标： 在全加州安装"智能仪表"和温控器

- Gives customers access to information and greater control over their energy use and bills.

  允许客户获取能源使用和账单信息的信息，扩大其相关控制权

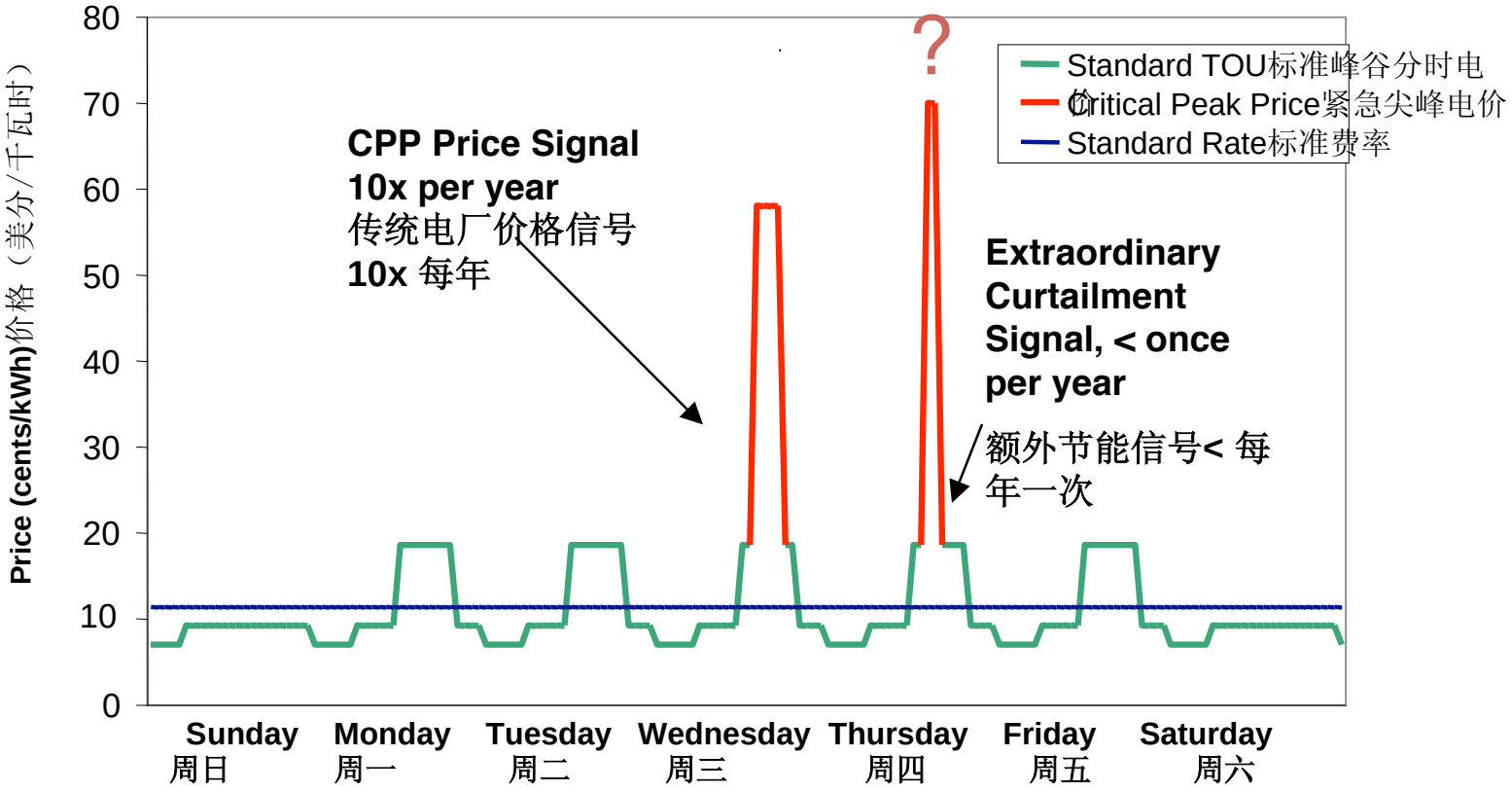
Critical Peak Pricing (CPP) with additional curtailment option

额外节能选项紧急尖峰电价（传统电厂）

Potential Annual Customer Savings:潜在的年度用户节约：

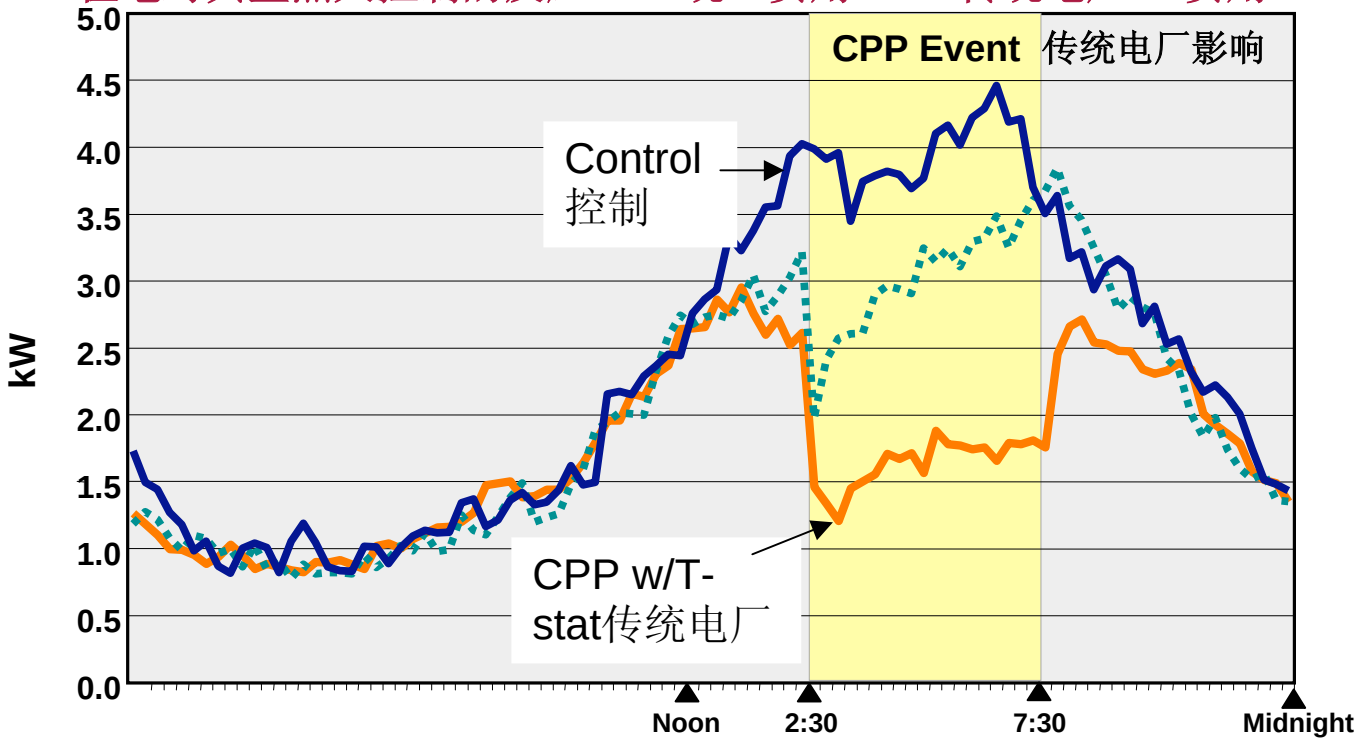
10 afternoons x 4 hours x 1kw = 40 kWh at 70 cents/kWh = ~$30/year

10下午x 4小时 x 1千瓦 = 40 千瓦小时， 40千瓦小时x70美分/千瓦小时 = ~$30/年



CPP rates – Load Impacts 传统电厂费用 – 负荷影响

Residential Response on a typical hot day
Control vs. Flat rate vs. CPP-V Rate
住宅对典型热天控制的反应 vs. 统一费用 vs. 传统电厂-V 费用



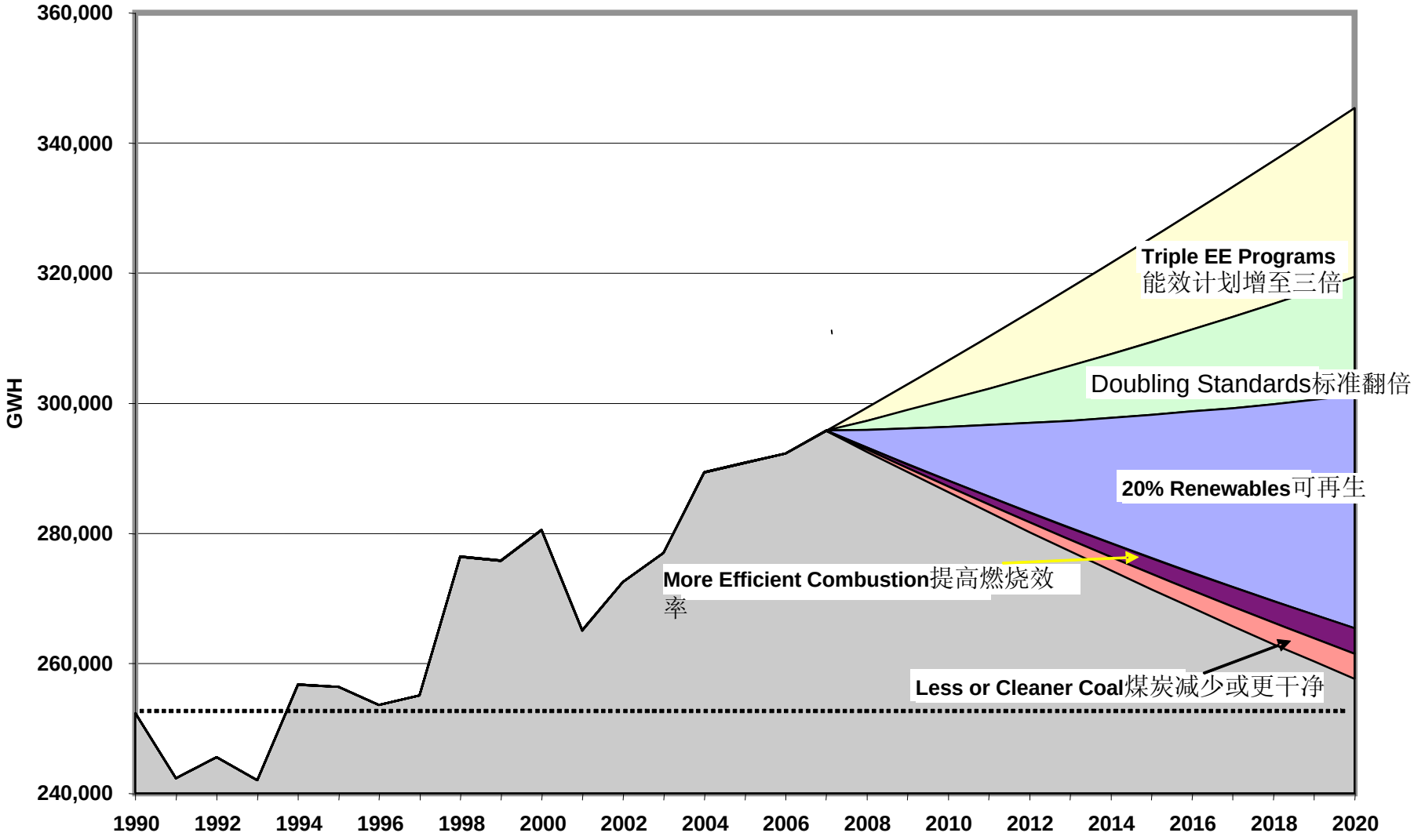
Most customers (~ 80%) Saved Money and Most (~60%) thought all customers should be offered this type of rate.大部分用户（约80%）节约费用，用户中的大部分（约60%）采用此类费率。

Source: Response of Residential Customers to Critical Peak Pricing and Time-of-Use Rates during the Summer of 2003, September 13, 2004, CEC Report.

来源： 2003年夏住宅用户对紧急尖峰电价和峰谷分时电价的反应，2004年9月13日

减少加州电力行业碳排放可能的策略，忽视提高倍数与其他执行结果 – 电力视角

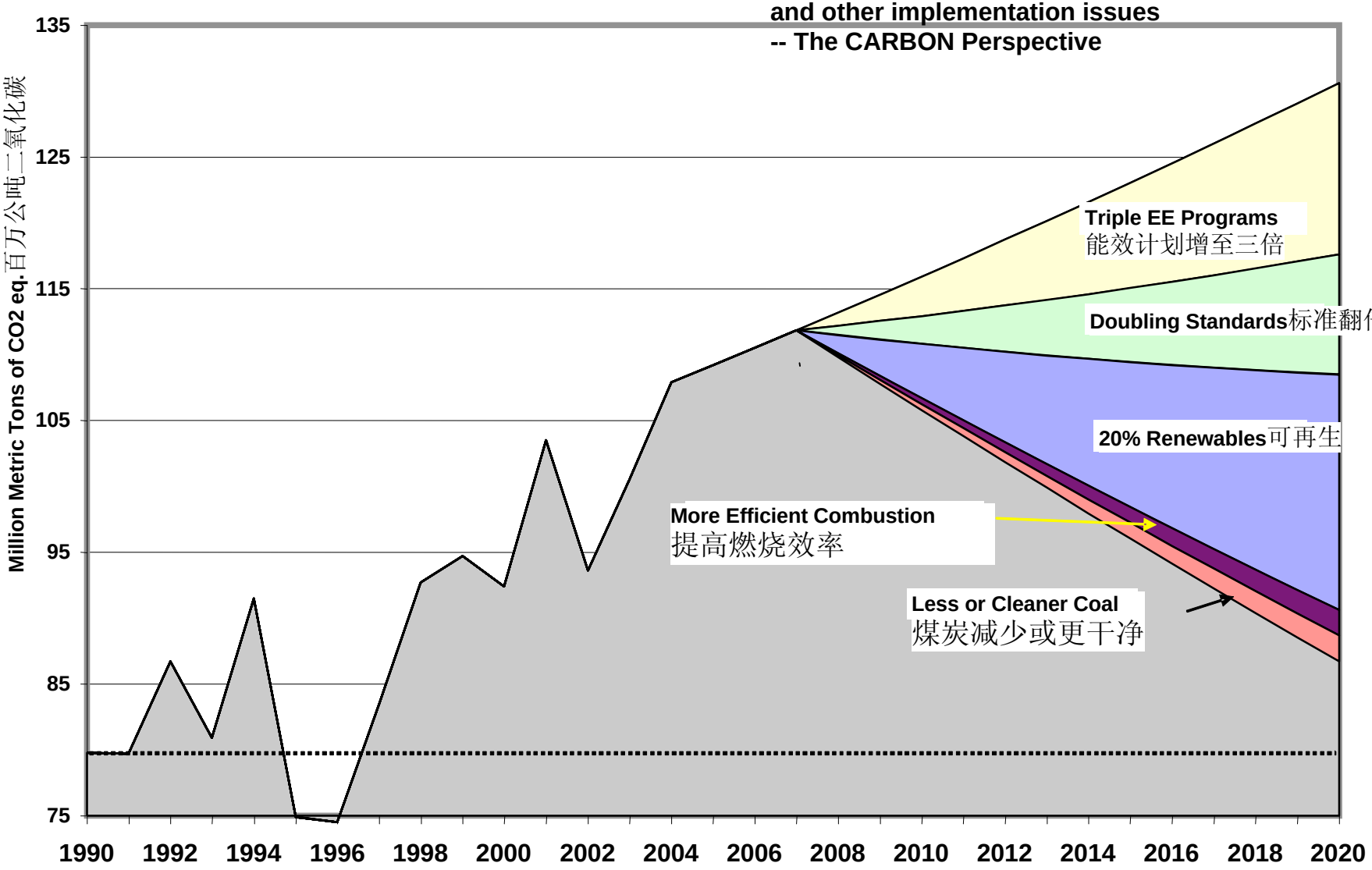
Possible Strategies to Reduce Electricity Sector Carbon Emissions in California, ignoring ramp up times and other implementation issues -- The ELECTRICITY Perspective



Source来源: Pat McAuliffe, pmcaulif@energy.state.ca.us

减少加州电力行业碳排放可能的策略，忽视提高倍数与其他执行结果 – 碳视角

Possible Strategies to Reduce Electricity Sector Carbon Emissions in California, ignoring ramp up times and other implementation issues
-- The CARBON Perspective



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